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Case Report Open Access

Intraoperative "Broken Heart" Cardiomyopathy with an "Inverted" Takotsubo Pattern

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Abstract

Takotsubo cardiomyopathy is a reversible form of acute heart failure first described in Japan, believed to be triggered by major stressful events in a patient's life. The patient's clinical presentation in conjunction with ECG analysis, echocardiography, and angiography depicts an ischemic event leading to LV dysfunction with no evidence of an acute coronary syndrome. Classically, the cardiomyopathy manifests itself as apical akinesis and ballooning on echocardiography mimicking the likeness of an octopus trap. Less commonly there have been reports of an inverted pattern type of Takotsubo cardiomyopathy with preserved apical wall function. We present the case of a 43 year old female who developed a transient inverted variant of Takotsubu cardiomyopathy during an elective herniorrhaphy. A postoperative transthoracic echocardiogram revealed severely reduced LV function with akinesis of the basal and posterior walls with severe mitral regurgitation. Cardiac catheterization failed to reveal significant lesions, and an intra-aortic balloon pump was placed for cardiac support. Over the next 5 days the patient's clinical picture improved markedly with complete normalization of LV function.

Background

Takotsubo cardiomyopathy, also known as stress-induced cardiomyopathy, is a rapidly reversible form of acute heart failure first described in Japan, believed to be triggered by major stressful events in a patient's life. The stressful event, usually emotional, but can be induced by physical factors, illness, medical/surgical procedures or sympathomimetic drugs. The patient's clinical presentation in conjunction with ECG analysis, a transthoracic echocardiogram, and left heart catheterization depicts an ischemic event leading to LV dysfunction with no angiographic evidence of thrombus or an acute coronary syndrome [1-6]. In the vast majority of the cases, the clinical signs and symptoms resolve quickly with normalization of the ejection fraction and complete recovery of the patient [3-6]. The inciting event is debatable but is believed to be a catecholamine surge triggering coronary vasospasm [6,7]. Classically, the cardiomyopathy manifests itself as apical akinesis and ballooning on both echocardiography and cardiovascular magnetic resonance imaging mimicking the likeness of an octopus trap. However, there have been reports of an inverted pattern type of Takotsubo cardiomyopathy. In this variant there is akinesia of the left ventricular base and/or mid-portion with preserved or hyper-dynamic apical wall function [8-10].

Case Report

We present the case a 43 year old female who developed an inverted variant of stress-induced cardiomyopathy intraoperative. A 43 year old woman was referred by the general surgery department of our hospital for unexplained hypotension which occurred during elective hernia repair. Earlier in the day, she had been admitted on an ambulatory basis for elective surgical repair of a recurrent ventral hernia with mesh implantation. On admission, she was noted to have a normal physical examination, with a blood pressure of 110/60 mm Hg, a heart rate of 76, and an oxygen saturation of 98% on room air. General anesthesia was induced and the procedure was started without incident. Approximately 45 minutes into the procedure, the patient became hypertensive and tachycardic, with a reported blood pressure of 165/110 mm Hg and a pulse rate of 150 bpm. Continuous cardiac telemetry monitoring revealed a supraventricular tachycardia. 5 mg of metoprolol tartrate were subsequently administered intravenously without any discernible effect. Fifteen minutes later, five mg of diltiazem was then administered intravenously. The patient's oxygen saturation decreased to 89% while being ventilated with 100% oxygen. Over the next 15 minutes, the blood pressure normalized, the supraventricular tachycardia broke and the rhythm returned to normal sinus at a rate of 90 bpm. After 15 minutes later, the blood pressure decreased to 90/60 mm Hg, and 10 micrograms of neo-synephrine was administered. Over the next 60 minutes, the patient remained persistently hypotensive with blood pressure readings of 70/50 mm Hg, with multiple doses of neo-synephrine and boluses of Ringer's lactate required to maintain blood pressure and hemodynamic stability.During this time, the endotracheal tube was also replaced two times without complication in an effort to correct hypoxemia and hypotension caused by any possible underlying tube malposition or main stem intubation without effect. A radial arterial line and a foley catheter were placed, and an arterial blood gas at this time revealed a blood pH of 7.32, a PCO_2 of 48, and a PO_2 of 89. The surgical procedure was concluded and the patient was transferred to the recovery room and referred to the cardiology department for evaluation. Blood loss during the procedure was estimated to be minimal.

The patient was noted to have a past medical history of gastro-esophageal reflux disease. She had previously had undergone laparoscopy for a reported history of pelvic inflammatory disease, a prior ventral hernia repair with mesh, and surgery for a deviated nasal septum, all without complication. She reported an allergy to ciprofloxacin, and the only medication she took was lansoprazole. She reported a ½ pack per day smoking history for many years but had quit smoking 3 years prior. She denied significant alcohol use or any drug

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use in the past. Her family history was remarkable only for diabetes mellitus.

The patient had undergone a cardiac evaluation 2 years prior for reported ECG abnormalities observed during a previous admission for workup of an episode of breast pain. At that time,she was found to have a normal physical examination with ECG findings of normal sinus rhythm with an rSr like pattern. A transthoracic echocardiogram at that time was notable for normal left ventricular dimensions, normal ventricular size and function, normal left atrial size, with no significant valvular pathology, other than mild mitral and tricuspid regurgitation. An exercise stress myocardial perfusion imaging study demonstrated normal stress ECG and hemodynamic responses, along with normal perfusion and normal wall motion, with an ejection fraction of 69%.

A preoperative evaluation performed 1 month prior to this admission again revealed a normal physical examination and a normal laboratory profile including complete blood count, comprehensive metabolic panel including liver tests, thyroid stimulating hormone, prothrombin and partial thromboplastin times, a total cholesterol of 159 mg/dL, an LDL cholesterol of 69 mg/dL and an HDL cholesterol of 58 mg/DL. A pre-operative ECG the morning of surgery revealed normal sinus rhythm with no significant ST or T wave abnormalities.

In the recovery room, the patient was maintained on mechanical ventilation, intravenous fluids, and intravenous fentanyl as needed for sedation. On examination, she was found to be afebrile, with a heart rate of 84 bpm, a blood pressure of 104/80 mm Hg, and an oxygen saturation of 100% while being ventilated with 70% oxygen. She was arousable and able to follow simple commands. No jugular venous distension noted and lung examination was significant for scattered rhonchi throughout all fields. Cardiac examination revealed a regular tachycardia and a III/VI systolic murmur heard best over the apex with no radiation pattern.No peripheral edema was observed.Troponin I level at this time was measured to be 0.034 ng/ml. Repeat ECG analysis demonstrated normal sinus rhythm without any evidence of ST segment deviation. An AP chest radiograph demonstrated possible bilateral infiltrates in the setting fluid overload.

A transthoracic echocardiogram performed at the patient's bedside in the recovery revealed normal left ventricular size but severely reduced left ventricular function. There was akinesis of the basal and mid septum, basal and mid posterior wall, and basal inferior wall. The right ventricular size and function were normal. The right and left atrium were normal in size. There was no pericardial effusion. Doppler examination demonstrated severe mitral regurgitation, mild tricuspid regurgitation, and an estimated pulmonary artery systolic pressure of 22 mm Hg. Repeat troponin I measurement was 0.113 ng/ml and creatinine kinase was 100 U/L. Given the clinical picture consistent with cardiogenic shock, the patient was taken for urgent cardiac catheterization for evaluation of acute coronary syndrome and possible placement of an intra-aortic balloon pump.

Left heart catheterization was performed via the right common femoral artery approach using a 6 French system. Selective angiography of the right and left coronary arteries revealed only minimal diffuse luminal irregularities without any evidence of obstructive or unstable lesions. Left ventriculography demonstrated severe systolic dysfunction with an estimated ejection fraction of 30% and akinesis of the anterior basilar and inferior walls, as well as hypokinesis of the mid anterior wall, with 3-4+ mitral regurgitation. Intra-aortic balloon pump was placed via the right femoral artery, and the patient was transferred to the coronary care unit in stable condition.

On admission to the coronary care unit, an EKG revealed normal sinus rhythm, non specific ST-T changes, and a mildly prolonged QT interval. The patient's hemodynamic status on day 1 of the CCU stabilized requiring no inotropic support, and with down titration of

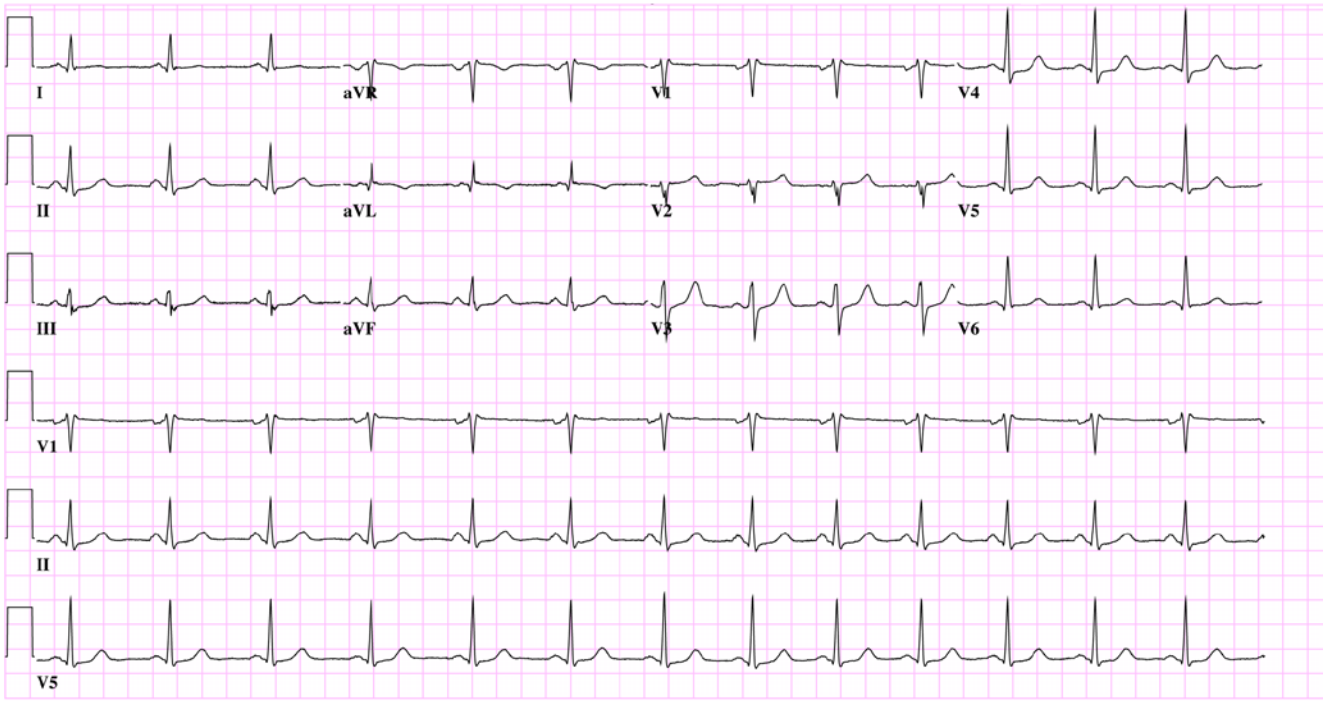

Figure1: ECG: 12 lead ECG on admission to CCU depicting normal sinus rhythm, with no significant ST segment or T wave abnormalities consistent with ischemia.

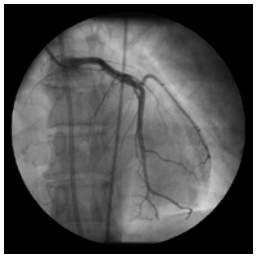

Figure 2: Left Heart Catheterization: depicting normal coronaries with no evidence of thrombus or significant stenosis.

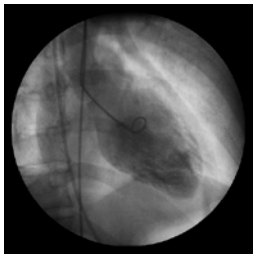

Figure 3: Left Ventriculogram- motionless, depicting normal apical wall anatomy with the absence of apical ballooning.

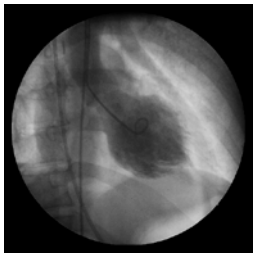

Figure 4: Left Ventriculogram: depicting systolic phase. Note the absence of the characteristic apical ballooning typically seen in Takotsubo cardiomyopathy.

the neosynephrine. By the end of day 1 the patient was no longer in cardiogenic shock. The patient was successfully extubated on hospital day 2 and the intra-aortic balloon pump was discontinued on hospital day 3. Over the next 4 days medical therapy for post cardiogenic shock secondary to stress induced cardiomyopathy was instituted which entailed escalating doses of carvedilol and captopril. Cardiac enzyme measurements had peaked within the first 24 hours, with a troponin I of 0.341 ng/ml and creatinine kinase of 3203 U/L. On hospital day 6 a repeat transthoracic echocardiogram was performed, which showed complete normalization of left ventricular function and resolution of mitral regurgitation. The patient was discharged home on hospital day 7 on a regimen including carvedilol and lisinopril, with outpatient cardiology follow up. Seven months after discharge, the patient was contacted via telephone where she denied any symptoms, hospitalizations, or cardiac workup since her last admission to our institution. She has not follow up in the cardiology clinic since her discharge.

Discussion and Review of Literature

The aforementioned case describes that of a woman who developed an inverted pattern of stress-induced cardiomyopathy intraoperative. Although catecholamine levels were not measured, it is clear from the initial presentation that the patient developed an adrenergic surge or catecholamine release evident from the supraventricular tachycardia and hypertension. It is presumed that the physiologic stress of the surgery triggered this state. Whilethere is no exact consensus on the prevalence of this inverted pattern in reported cases of Takotsubo cardiomyopathy, it is generally perceived to be a rare variant. In a retrospective study performed by Jabara R et al, they reported a 24% figure for non-LV apical ballooning in their selected patient population for clinical comparative purposes. The non-apical LV ballooning type can be characterized by either mid-ventricular akinesia, or akinesia involving the LV base. The "inverted Takotsubo," pattern with basal akinesia and ballooning has been reported less frequently in the literature than mid-ventricular akinesia [11]. Inverted Takotsubo cardiomyopathies have been reported in patients who have experienced acute cerebrovascular accidents [12], pheocromocytoma [13], paragliomas [14], acute pancreatitis [15], amphetamine use [16] and shoulder surgery [17]. Of these inciting events, cerebrovascular accidents and pheocromocytoma were the most common. More recently, in 2010, Lee et al presented two unique case reports of inverted takotsubo cardiomyopathy. One case involved a 41 year old woman who developed cardiogenic shock with LV systolic dysfunction with akinesis of the LV base with hyper-contractability of the apex in the setting of severe sepsis.In another setting, similar echocardiographic findings were depicted in the case of 30 year old woman 5 days postpartum cesarean delivery. Both of these patients received standard heart-failure treatment, including diuretics and angiotensin-converting enzyme inhibitors. The first case required the assistance of an intra-aortic balloon pump and inotropic support. Complete resolution of symptoms with recovery of cardiac function was observed in both of these patients within two weeks of the initial diagnosis [10].

Often of times, the inciting event is less severe. Tomcsanyi et al in 2008 presented the case of a 36 year old female who after an injection of lidocaine with adrenaline for plastic surgery of the ear developed inverted Takotsubo cardiomyopathy with akinesis of basal segments and hyperkinetic apex. The symptoms resolved and cardiac function recovered in 3 days [18]. In 2010 Gervais MK et al uncovered a pheocromocytoma initially presenting as cardiac failure secondary to inverted Takotsubo cardiomyopathy. The echocardiogram showed the classic wall motion abnormalities with reduced ejection fraction. CT of the abdomen/pelvis revealed a left adrenal mass, confirmed by elevated urinary catecholamine levels. The patient ultimately underwent left adrenalectomy with complete resolution of symptoms [19].

In the case mentioned above, the ECG finding at presentation was normal sinus rhythm without any ST segment abnormalities and with only mild troponin elevation. In a study performed by Jabara R et al, a comparison was made between the clinical characteristics of apical and non-apical variants of Takotsubo cardiomyopathy in the United States. In this study a total 38 patients from 2004 to 2007 who fulfilled the clinical criteria for stress-induced cardiomyopathy were analyzed. Of these patients, the study showed that patients with the "apical form" presented predominantly with ST elevations, higher incidence of hypertension, higher levels of troponin and lower ejection fractions when compared to the non-apical subjects. It was also noted that severe complications such as pulmonary edema and ventricular tachycardia only occurred in the "apical form" subjects [11].

The pathophysiology behind takotsubo cardiomyopathy remains unclear. It has been hypothesized that a catecholamine surge engenders coronary vasospasm and/or endothelial dysfunction causing the wall motion abnormalities. Histopathological studies performed by Wani

et al have shown characteristic band necrosis and focal mononuclear inflammatory infiltrates with areas of fibrosis in the LV apex and base in patients with Takotsubo cardiomyopathy who underwent biopsy [20]. These pathology findings are thought to be specific for a catecholamine surge. In these same patients endothelial dysfunction was demonstrated by a lack of vasospastic response to nitroglycerine, acetylcholine and adenosinetesting [20]. The density of adrenergic receptors increases from the base towards the apex along the left ventricle in humans. This offers a possible explanation for the typical wall motion abnormality seen in Takotsubo cardiomyopathy. However, the pathophysiology of the inverted variant is unclear. We propose that variations in the density of adrenergic receptors along the left ventricle in humans can serve as a potential explanation for this phenomenon.

Conclusion

We present the case of inverted Takotsubo cardiomyopathy intraoperative in a 43 year oldwoman. In the event of sudden clinical cardiac hemodynamic instability perioperative in an otherwise normal female, the diagnosis of stress-induced cardiomyopathy of either variant should be entertained once acute coronary syndrome has been eliminated. Inverted Takotsubo has been observed much less frequently in the literature compared to the classical apical ballooning syndrome. This case report adds to the growing literature of reported cases of inverted stress induced cardiomyopathy. It has been reportedin various clinical situations, including pheocromocytomas, CVAs, amphetamine use, sepsis, as well as intraoperative.Initial studies suggest that this variant of stress induced cardiomyopathy portends less severe complications in contrast to the more commonly seen apical ballooning syndrome [11].

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